

respectively, and a heavy frost was reported on the 18th, when a minimum temperature of 36° was reached at the same station.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT.

Two very distinct pressure types were alternately in control of weather conditions in the Pacific States during November—high pressure over the western part of the United States was dominant during the forepart of the month and low pressure during the latter part.

Except for a disturbance for which southwest storm warnings were displayed in Oregon and Washington on the 4th, the weather was settled and rainless in most sections, with a hot spell in California until the 14th. On that date a disturbance entered the north coast and moved southeastward over the plateau. Its passage was followed by a series of heavy frosts in California extending from the 16th to the 20th. All of the severer ones were covered by warnings. The freezing temperatures did not reach southern California until the 18th, a day later than was expected, due to the sluggish eastward movement of the low then centered in Arizona, and one unverified warning of light frost was issued as a result.

Coincident with the passage of this storm was the southward advance of the Alaska high. Colder weather in connection with this movement was foreseen in the northwest, and special warning was sent on the 17th to fruit storage and shipping interests in northeastern Washington of an expected period, with temperatures considerably below freezing. This warning was fully justified by the event.

From the 19th until the close of the month the weather in this district was dominated by the North Pacific low-pressure system which shifted southeastward so as to impinge on the Pacific coast. So plain was the evidence of a change in weather type that advice was issued several days in advance to forestry parties in the high Sierra of impending snowfall that would impede their withdrawal from the mountains.

Southeast storm warnings were put up at Oregon and Washington seaports on the 19th and displayed thereafter with but few interruptions until the 30th. Occasionally they were altered in direction, and on two occasions they were extended to include the California coast as far south as Mendocino. There was one marine casualty of note during this time. The tug *Sea Eagle*, which left San Francisco for Coos Bay on the 16th, never arrived at that port. All that is known regarding her loss is deduced from some of her wreckage washed ashore on the Oregon coast a few miles south of the Columbia River on the 24th.

Forecast problems this month clearly illustrated the value of timely vessel weather reports. Several failures to accurately predict the weather in this district may be attributed to the nonreceipt of such reports. Two ill-advised frost warnings for northern California, those of November 23 and 28, may be explained thus: In the case of the first one it was seen a few hours after the forecast had been made that conditions presaged rain rather than frost, the *S. S. Eldridge* reporting from a position off the southern Oregon coast facts which contained the information requisite for an intelligent prediction. On the other hand, a number of forecasts for California, Oregon, and Washington were influenced in the right direction through the aid derived from a knowledge of conditions over the adjacent ocean.—*Thomas R. Reed.*

MEAN LAKE LEVELS DURING NOVEMBER, 1921.

By UNITED STATES LAKE SURVEY.

[Detroit, Mich., December 3, 1921.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes. ¹			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during November, 1921:				
Above mean sea level at New York.....	<i>Feet.</i> 602. 20	<i>Feet.</i> 579. 64	<i>Feet.</i> 571. 80	<i>Feet.</i> 244. 85
Above or below—				
Mean stage of October, 1921.....	—0. 33	—0. 22	+0. 01	—0. 26
Mean stage of November, 1920.....	—0. 23	—0. 66	—0. 15	—0. 38
Average stage for November, last 10 years.....	—0. 39	—0. 67	—0. 12	—0. 80
Highest recorded November stage.....	—1. 31	—3. 23	—1. 87	—2. 97
Lowest recorded November stage.....	+0. 70	+0. 46	+1. 10	+1. 44
Average relation of the November level to—				
October level.....		—0. 20	—0. 20	—0. 20
December level.....		+0. 10	+0. 10	+0. 10

¹ Lake St. Clair's level: In November, 574.55 feet.

627.41 (73)

RIVERS AND FLOODS.

By H. C. FRANKENFIELD.

Atlantic drainage.—The heavy rains from November 26 to 29 caused decided rise in the rivers of New York and Pennsylvania, although flood stages were not reached in the Hudson River system. Flood stages were also approached or slightly exceeded in the North Branch of the Susquehanna and its tributaries, but the total damage reported was only about \$8,000.

Over the South Atlantic drainage area there were no floods except a very moderate one in the Santee River during the early days of the month, due to heavy rains on October 30 and 31. There was no damage. A flood warning on November 28 for the Santee River was not quite justified, probably owing to the dry period that preceded the rainfall.

Mississippi drainage, Ohio branch.—Moderate rains that fell on a previously dry soil from November 24 to 29, inclusive, caused a rapid rise in the upper Ohio River and its tributaries, and flood stages prevailed along the river almost as far as Parkersburg, and also in the vicinity of Point Pleasant, W. Va. Warnings were first issued on November 28, and the crest stages reached did not differ materially from the forecast stages.

The crest stage at Pittsburgh was 25.4 feet, 3.2 feet above the flood stage, at 2 p. m. November 29; at Marietta, Ohio, 34 feet, or 1 foot above the flood stage, at 10 p. m. November 30; at Parkersburg, W. Va., 35.9 feet, 0.1 foot below the flood stage, at 1 a. m. December 1; and 43.5 feet, or 3.5 feet above the flood stage, from 2 p. m. November 30 to 6 a. m. December 1. The flood stage at Point Pleasant was due to the run-off from the Great Kanawha River and had little or no effect on the Ohio River below.

The Monongahela, Kiskiminetas, lower Allegheny, Little Kanawha, and lower Licking Rivers also experienced flood stages.

The total of losses and damage reported in the Pittsburgh district amounted to about \$25,000 and in the Parkersburg district to about \$10,000.

Heavy rains from November 16 to 18, inclusive, averaging from 3 to more than 6 inches over portions of Indiana, Kentucky, and Illinois, caused unusually rapid rise in the Wabash and White Rivers. Warnings for the

White River were first issued on November 18 and frequently thereafter.

Although flood stages were general over the lower watersheds, the only losses of consequence were of corn in the fields, the value of which was probably about \$20,000. The warnings were of great value to those having portable property in the lowlands.

Frequent warnings were also issued, beginning with November 18, for the Wabash River. The crest stage at Lafayette, Ind., was 20 feet, or 9 feet above flood stage, on November 21; at Terre Haute, Ind., 18.9 feet, or 2.9 feet above flood stage, on November 24 and 25; at Vincennes, Ind., 16.9 feet, or 2.9 feet above flood stage, on November 28; and at Mount Carmel, Ill., 21.8 feet, 6.8 feet above flood stage, on November 29.

The losses and damage reported amounted to about \$165,000, mostly in unhusked corn, while the estimated property saved through the Weather Bureau warnings was about \$150,000.

While flood stages were not reached in the Green and Big Barren Rivers, and in the Evansville district of the Ohio River, yet it was thought advisable by the official in charge of the district to issue flood warnings on November 19 in order that farmers might be enabled to save the larger quantities of corn in the lower bottoms, and this was done.

Later in the month another protracted rain period necessitated additional warnings for the Ohio and Green Rivers, beginning with November 27, and ending with December 5. The rise from the upper Ohio River reached the Evansville district about the end of the month, and materially increased the Ohio River stages. The crest at Evansville was 39.58 feet, at 1 p. m. December 6; forecast stage near 40 feet; at Henderson, Ky., 37.5 feet, at 7 a. m. December 7; forecast stage near 38 feet, and at Mount Vernon, Ind., 38.8 feet, at 4 p. m. December 7; forecast stage, near 39 feet. The Green River was also in flood, and did not fall below the flood stage at Lock No. 2, Rumsey, Ky., until 2 p. m., December 8.

While much inconvenience resulted, there were no losses of consequence, as the corn had been gathered upon advices issued during the previous rise.

Mississippi system.—The heavy rains of November 18 and 19 also caused a rather rapid rise in the Illinois River, the Missouri River below Jefferson City, Mo., the Meramec River, and the Mississippi River between Grafton, Ill., and Cape Girardeau, Mo. However, flood stages were not reached, except in the Illinois and Meramec Rivers.

Warnings for the Illinois River were first issued on November 20. The Illinois River floods are very slow, and the river was still in flood at the close of the month, with another rise in prospect. The warnings were sufficiently timely to prevent inconvenience or loss.

Warnings for the Meramec River were issued on November 19, and were fully verified. There was some inconvenience but no losses of consequence.

Lake Erie drainage.—There was a moderate flood in the Maumee River at Fort Wayne, Ind., on November 21, due to the general rains from November 16 to 19, inclusive, combined with a moist soil resulting from melting snow previous to November 15. From November 16 to November 21, the river at Fort Wayne rose from 4.5 to 16.1 feet (flood stage 15 feet), and warnings were issued on November 19, when the river stood at 12.7 feet. Lowlands were inundated, but there was no other damage.

There were no other floods except in the Willamette system. These latter were caused by a rainfall of from 4 to 7.5 inches between November 19 and 21, and the

crest stages were from 1 to 9.5 feet above the flood stages, the greatest excess occurring in the Santiam River at Jefferson, Oreg. On November 30 flood stages were again reached in the Santiam River and in the Willamette at Eugene, Oreg. Warnings were issued on November 21. Considerable damage was done to bridges, buildings, and fences near Jefferson, Oreg., but no serious damage at other points. The warnings were sufficiently in advance to admit of the removal of portable property to places of safety.

On November 1, 1921, the supervision of the river district of the Red River of the North was transferred from the Weather Bureau office at Devils Lake, N. Dak., to the office at Moorhead, Minn., its original location.

Flood stages during November, 1921.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE.					
<i>Mohawk:</i>	<i>Feet.</i>			<i>Feet.</i>	
Tribeshill, N. Y.....	16	28	29	18.8	28
<i>Susquehanna:</i>					
Oneonta, N. Y.....	12	28	30	14.0	29
Bainbridge, N. Y.....	11	28	28	14.9	28
Binghamton, N. Y.....	14	29	29	14.3	29
Wilkes-Barre, Pa.....	20	29	(*)	22.4	29
<i>Unadilla:</i>					
New Berlin, N. Y.....	8	28	28	8.0	28
<i>Santee:</i>					
Rimini, S. C.....	12	3	5	12.4	4
GREAT LAKES DRAINAGE.					
<i>Maumee:</i>					
Fort Wayne, Ind.....	15	20	22	16.1	21
MISSISSIPPI DRAINAGE.					
<i>Ohio:</i>					
Pittsburgh, Pa.....	22	29	29	25.4	29
Davis Island Dam, Pa.....	25	29	29	25.3	29
Beaver Dam, Pa.....	30	29	(*)	34.2	29
Marietta, Ohio.....	33	30	(*)	34.0	30
Point Pleasant, W. Va.....	40	30	(*)	43.5	30
Dam No. 29, Ky.....	50	30	30	50.3	30
Evansville, Ind.....	35	30	(*)	35.1	30
<i>Allegheny:</i>					
Harris Island Dam, Pa.....	22	29	(*)	25.7	29
<i>Conemaugh-Kiskiminitas:</i>					
Saltsburg, Pa.....	8	29	29	14.7	29
<i>Stony Creek:</i>					
Johnstown, Pa.....	10	28	29	12.3	28
<i>Monongahela:</i>					
Lock No. 15, W. Va.....	22	28	29	23.8	28-29
Lock No. 7, Pa.....	30	29	29	32.0	29
Lock No. 4, Pa.....	31	29	29	34.9	29
<i>Little Kanawha:</i>					
Glenville, W. Va.....	23	29	29	24.1	29
Creston, W. Va.....	20	29	29	20.3	29
<i>Licking:</i>					
Falmouth, Ky.....	28	17	18	29.8	17-18
<i>Green:</i>					
Lock No. 6, Ky.....	30	30	(*)	31.0	30
Lock No. 4, Ky.....	33	29	(*)	38.1	30
<i>Wabash:</i>					
Terre Haute, Ind.....	16	20	28	18.9	25
Mount Carmel, Ill.....	15	21	(*)	21.8	29
<i>White:</i>					
Decker, Ind.....	18	24	(*)	21.5	28
<i>Illinois:</i>					
Peru, Ill.....	14	21	(*)	15.5	24
Henry, Ill.....	7	22	(*)	9.1	27, 29
Peoria, Ill.....	16	27	28	16.1	28
Beardstown, Ill.....	12	27	(*)	12.8	30
<i>Meramec:</i>					
Pacific, Mo.....	11	21	22	13.4	21
Valley Park, Mo.....	14	21	22	16.2	21
<i>Bourbeuse:</i>					
Union, Mo.....	10	21	21	10.9	21
<i>Petit Jean:</i>					
Danville, Ark.....	20	19	22	23.9	20
PACIFIC DRAINAGE.					
<i>Willamette:</i>					
Eugene, Oreg.....	10	21	22	14.0	22
Albany, Oreg.....	20	23	24	23.2	23
Salem, Oreg.....	20	22	24	24.5	22
Oregon City, Oreg.....	12	22	26	15.1	23
Portland, Oreg.....	15	23	25	17.0	23
<i>McKenzie:</i>					
Hendricks Bridge, Oreg.....	14	21	21	15.0	21
<i>Santiam:</i>					
Jefferson, Oreg.....	10	21	23	19.5	21
	10	30	(*)	13.0	30
<i>Yamhill:</i>					
McMinnville, Oreg.....	35	22	23	39.4	22
<i>Clackamas:</i>					
South Fork, Oreg.....	12	19	20	14.8	19

* Continued into December.

Spind